

RETROSPECTIVE STUDY ON CAUSES OF AMPUTATION

MD PHYSICAL & REHABILITATION MEDICINE

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# INTRODUCTION

Amputation is the most ancient of all surgical procedures with a history of over 2500 years going back to the time of Hippocrates.

Amputation is generally performed for a variety of indications including trauma, peripheral vascular disease, tumour, infection and congenital anomaly, but cause of amputation vary between and within countries.

The life expectancy and outcomes of persons with amputation is same as normal person except with any associated medical comorbidities.

With the advances in rehabilitation medicine, now any amputee patient at any level of amputation and associated with any deformities can be fitted with prosthesis.

## **AIM OF STUDY**

The aim of the study is to find out the cause of amputation and preventive measures needed to avoid such complications. Amputation impact can be frightening and challenging experience for the amputees and their families. Amputees become the responsibility of the health service and if not well looked after, they may continue crippled for life.

# REVIEW OF LITERATURE

## HISTORY

Hegesistratus in 484 B.C who was imprisoned, chained at ankle and was awaiting death penalty, at his attempt to escape, he cut his foot and after wound healing he started using a wooden leg.

- ❖ Artificial hands made of iron were used by Knights in 15<sup>th</sup> century.
- ❖ Hippocrates in 4<sup>th</sup> century BC reported about ligatures which was reintroduced by Ambrose pare, a French military surgeon in 1529.
- ❖ Morel introduced the tourniquet in 1674.
- ❖ Pare carried out the first elbow disarticulation in 1536.
- ❖ Sir James Syme reported his procedure for amputation at the ankle in 1843.
- ❖ Lord Lister in 1867, introduced the antiseptic technique.
- ❖ First hip disarticulation was done by William Kerr of England in 1774.
- ❖ Transmetatarsal disarticulation was done by Lisfranc, a French surgeon in 1815.
- ❖ Myoplasty was introduced by Burgess in 1956.

- ❖ Immediate post operative prosthesis was fitted by Michael Berlemont in 1958.
- ❖ Canadian hip disarticulation prosthesis was designed at Sunny brook hospital Toronto in 1954. In 1955 Canadian syme's prosthesis designed at same hospital.
- ❖ SACH foot was introduced by university of California in 1955.
- ❖ In India first artificial limb center was started in Defence Medical College, Pune.
- ❖ Following that artificial limb center was started in south part of India, Madras 1965 in Madras Medical College. Then it was shifted to present place Government Institute of Rehabilitation Medicine (GIRM) Chennai-600083 in 1968.

## EPIDEMIOLOGY

Data from the Agency for Health Care Research and Quality (AHRQ) and the Veteran Health Administration (VHA) from date 1980 to 1990 estimates that a total of 1,40,000 amputations are performed yearly in United States.

Acquired amputation accounts for 96% to 99% all limb loss with the remaining 1% to 4% related to congenital causes.

Ratio of upper and lower limb amputation is 1: 4.9. In the lower extremity 75% to 93% of acquired amputations are the results of vascular disease (Diabetic vascular disease, atherosclerosis, immunologic and idiopathic), 6% to 10% of acquired lower extremity amputation results from traumatic injuries.

In upper extremity, trauma is the leading cause of limb loss accounting for 80% of amputations. Males in the age group of 20-40 are affected in large numbers. The average age of Indian amputees are lower than Western amputees.

## STATISTICS IN UPPER LIMB AMPUTATION

### *United States*

1. Prevalence rate in 1996 : 4.9 / 1000 person
2. Incidence rate
  - a. Vascular disease 46.2 / 1,00,000 person

- b. Trauma : 5.86 / 1,00,000 person
- c. Malignancy : 0.35 / 1,00,000 person
- d. Congenital limb deficiency : 25.64 / 1,00,000 live birth

	<i>Lowerlimb</i>	<i>Upperlimb</i>
Congenital	58.5/ 1 lakh limb loss	41.5 / 1 lakh limb loss.
Cancer	23.9/ 1 lakh limb loss.	76.1/ 1 lakh limb loss.
Trauma	68.6/ 1 lakh limb loss.	31/ 1 lakh limb loss.
Vascular	3/ 1 lakh limb loss.	97/ 1 lakh limb loss.

## **TRAUMATIC AMPUTATION**

Traffic accidents (cars, motor cycle, train etc...)

Industrial accidents (Equipments, press machines, wood machines etc)

Agricultural accidents

Electric shock

Fire works,Explosives,weapon

Building works

- ❖ Traffic accidents: 30.75% Industrial accidents 69.24%
- ❖ 0.7% Diabetics had a lowerlimb amputations in Australia 2002 (AIHW)

## LEVELS OF AMPUTATION

<i>Upperlimb amputation</i>	<i>Incidence</i>
Transradial amputation	57%
Transhumeral amputation	23%
Wrist disarticulation	7%
Elbow disarticulation	5%
Shoulder disarticulation	8%

<i>Lowerlimb Amputation</i>	<i>Incidence</i>
Transtibial amputation	59%
Transfemoral amputation	35%
Symes amputation	4%
Hip disarticulation	1%
Knee disarticulation	1%

Upperlimb amputation 1% : Lowerlimb amputation 4%



## CAUSES OF AMPUTATION

1. Trauma
2. Vascular disease
3. Malignancy
4. Congenital

Trauma: Traumatic loss of a limb is the most common cause of amputation.

The extent of injury to the musculoskeletal system depends on three interacting factors.

1. Movement of the object that causes the injury
2. Direction, magnitude and speed of the energy vector
3. Particular body tissue involved.

In partial traumatic amputation, atleast one half of the diameter of the injured extremity is severed or damaged significantly. This kind of injury can cause extensive bleeding.

A second type of traumatic amputation occurs when the limb becomes completely detached from the body. As much as 1 liter of blood may be lost before the artery becomes vasoconstrictive.

## **VASCULAR**

Common causes of vascular etiology are Diabetes and TAO. As per latest study on Diabetes in Tamilnadu 17% of population has Diabetes Mellitus.

## **MALIGNANCY**

Mainly osteosarcoma and fibrosarcoma are the main causes of amputation. Osteosarcoma is a fast growing tumour with secondaries in lung. So, it has to be taken care before going for prosthetic fitting.

## **CONGENITAL LIMB DEFICIENCY**

### ***Risk factors***

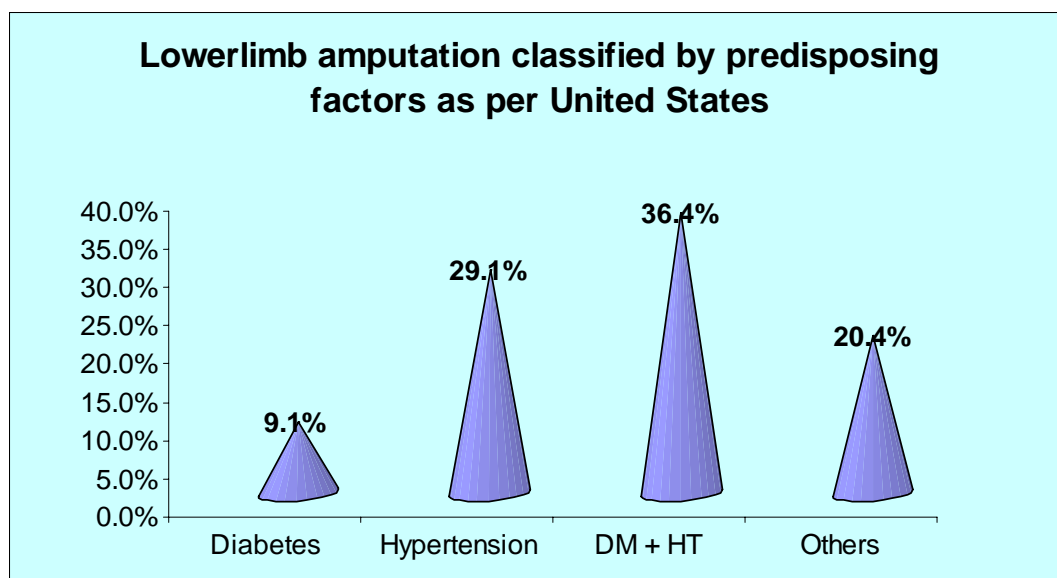
- \* Exposure to drugs like LSD, chemicals
- \* Fetal position and constriction
- \* Endocrine disorders
- \* Exposure to radiation
- \* Immune reactions
- \* Occult infections and other disease
- \* Single gene disorders
- \* Chromosomal disorders

***Transverse deficiencies:*** Described by the level at which the limb terminates

**Longitudinal deficiencies:** Reduction or absence occurs within the long axis of the limb but normal skeletal components are present distal to the affected bones.

***Classification of longitudinal congenital limb deficiencies***

<b><i>Limb segment</i></b>	<b><i>Upper extremity bone segment</i></b>	<b><i>Lower extremity bone segment</i></b>
Proximal	Humeral	Femoral
Distal	Radial Central ○ Carpal ○ Metacarpal ○ Phalangeal	Tibial Central ○ Tarsal ○ Metatarsal ○ Phalangeal
Combined (Indicated by bone segments remain)	○ Partial or complete ○ Specific carpal, ray (or) Phalanx remaining	○ Partial or complete ○ Specific carpal, ray (or) Phalanx remaining



Others - combination of risk factors including race, gender, smoking, previous vascular surgery.

# PATHOPHYSIOLOGY

## *I) Diabetes and amputation:*

Diabetic neuropathy-Nerve damage that occurs in the network of nerves that innervate feet, thus pain sensation decreases and if any cuts occurs, it may lead to complication and then amputation.

Vascular changes-Blood vessels narrow and reduce blood supply to the feet and leg. This combination of reduced blood flow, reduced oxygen supply and reduced pain sensation can increase the probability of infection, tissue damage and amputation.

Infection-nail disorders and foot disorders can also lead to amputation.

## *II) Tumors and amputation*

### **Criteria for limb saving procedure**

1. An oncologically sound wide or radical resection of the tumour is possible.
2. Limb reconstruction is technically feasible.
3. The prognosis in terms of survival and local recurrence is not compromised.
4. The cosmetic and functional results are superior but reconstructing a functional and cosmetically appearing limb.

If any one or more of criteria are not attained, then amputation is treatment of choice.

### ***III) Peripheral vascular disease:***

Dry gangrene is a result of reduced arterial inflow or stasis in the circulation of the limb or digit. Demarcation develops in the early and is usually clear cut, with resultant mummification and sometimes undergo autoamputation

Wet gangrene develops in both arterial and venous obstruction.

Leriche and Fontaine's classification of peripheral arterial disease severity:

<b><i>Stage</i></b>	<b><i>Examination findings</i></b>
I. Atherosclerosis without major clinical symptoms	Paresthesia, Cold extremities, Bruits on auscultation. Absent, diminished or normal pedal pulse, ABI <90 - Decreased peak flow (Plethysmography)
II (a) Atherosclerosis with claudication	As above with diminished or absent pedal pulses, Pain with walking distance >200 meters relieved with rest, Bruits on auscultation, Abnormal doppler sounds, Decreased peak flow.
II (b) Atherosclerosis with claudication	As above with more pronounced symptoms, Pain with walking distance <200 meters relieved with rest, Slight elevation in blood viscosity, fibrinogen & platelet function

<i>Stage</i>	<i>Examination findings</i>
III Atherosclerosis with resting pain. (critical limb ischemia)	Above symptoms present,Pain most troubling at night, Segmental pressure at ankle <50mm of Hg, Segmental pressure at toe < 30mm of Hg, Diminished TCO <sub>2</sub> . Trophic changes in nails, Atrophy of intrinsic muscles of foot
IV. Atherosclerosis with tissue damage (critical limb ischemia)	Above symptoms present,Dry gangrenous wound, Ulcer with inflammation or infection, Non healing plantar neuropathic ulcer in those with diabetes

#### **MANGLED EXTREMITY SYNDROME INDEX - MESI**

<i>No:</i>	<i>Component</i>	<i>Criteria</i>	<i>Score</i>
1.	Injury severity	0-25,25-50,>50	1,2,3
2.	Injury type	Guillotine	1
		Crush or burn	2
		Avulsion or degloving	3
3.	Nerve injury	Contusion, Transection, Avulsion	1,2,3
4.	Vascular injury	Arterial transection, thrombosis, Avulsion; Any venous injury	1,2,3 1
5.	Bone injury	Simple fracture	1
		Segmental fracture	2
		Segmental comminuted	3
		Segmental comminuted <6cm loss	4
		Segmental fracture involving joint	5

<i>No:</i>	<i>Component</i>	<i>Criteria</i>	<i>Score</i>
		Segmental fracture at joint <6cm	6
		Bone loss and Any bone loss >6cm	Add 1
6.	Time since injury	Every hour>6hour	Add 1
7.	Age	40-50,50-60,60-70 years	1,2,3
8.	Preexisting disease		1
9.	Shock		2

### *Interpretation*

<20points total =limb salvage possible

>20points total = Amputation is recommend

## **INVESTIGATIONS**

### *Investigations for vascular disease*

- 1) Capillary refill time - Delayed refill signifies arterial occlusion
- 2) Doppler ultra sound - Triphasic on auscultation normal person
  - i. Biphasic / Triphasic in mild impairment
  - ii. Absent on complete occlusion
- 3) Ankle brachial Index (ABI)
  - i. Normal 0.9 – 1
  - ii. <0.9 impaired arterial flow
- 4) Segmental blood pressure
  - i. > 20 mmHg decrease is systolic pressure between adjacent site - Possible occlusion



ii. >10mmHg decrease in systolic pressure between adjacent site -

Possible vessel calcification

5) Pulse volume recording – Flattening on recording suggest occlusive disease

6) Trans cutaneous oxygen pressure - <20mm Hg - predict nonhealing of ulcer

7) Doppler scanning – Velocity ratio > 4 or peak velocity >400cm /sec indicates >75% stenosis

8) Angiography

9) Venogram

10) Thermography

### ***Investigation for Diabetes***

Blood sugar, Urine sugar and ketone bodies

### ***Investigation for trauma***

X-Rays, Estimation of skin loss

### ***Investigation for tumors***

X-Rays skeletal including bone scan, angiography and computerized axial tomography, Biopsy

## **REHABILITATION OF AN AMPUTEE**

This is implemented by the rehabilitation team which is lead by the physiatrist. The team is comprising of surgeon, related specialists, clinical psychologist, physiotherapist and prosthetist.

Amputation rehabilitation programe includes:

1. Treatments to help improve wound healing and stump care.
2. Activities to help improve motor skills, restore activities of daily living and help the patient to reach maximum possible.
3. Exercices that promote muscle strength, endurance and control.
4. Fitting and use of prosthesis.
5. Pain management for both post operative and phantom pain.
6. Emotional support to help during the grieving period and with readjustment to a new body image.
7. Use of assitive device.
8. Nutritional counseling to promote healing and health.
9. Vocational counseling.
10. Adopting the home environment for ease of function, safety, accessibility and mobility.
11. Patient and family education.

*The success of rehabilitation depends on many variables, including the following:*

- ❖ Level and type of amputation
- ❖ Type and degree of any resulting impairments and disabilities
- ❖ Overall health of patient
- ❖ Family support

It is important to focus on maximizing the patients capabilities at home and in the Community. Positive reinforcement helps recovery by improving self esteem and promoting independence. The rehabilitation program is designed to meet the need of the individual patient. Active involvement of the patient and family is vital to the success of the program.

The goal of rehabilitation after an amputation is to help the patient return to the highest level of function and independence possible, while improving the quality of life physically, emotionally and socially.

#### **STAGES OF REHABILITATION IN AMPUTEE**

1. Pre amputation counseling
2. Amputation surgery
3. Acute post-amputation care
4. Preprosthetic training

5. Prosthetic fitting and training
6. Reintegration into community
7. Vocational rehabilitation
8. Long term follow up

### ***Pre amputation counseling***

To prepare the patient physically and mentally for amputation and post amputation period.

1. Communication involving patient, patient's family to explain about need for surgery and outcome.
2. Communication between surgeon, physiatrist, prosthetist to discuss about level of amputation and prosthetic fitting.
3. Introductory session with patient regarding
  - a. Phantom limb sensation
  - b. Prosthetic fitting
  - c. Mode of fitting and training
  - d. Time taken
  - e. Cost expenditure
4. Demonstration by a trained volunteer and discussion between patient and volunteer
5. Pre-rehabilitation exercise program involving other limbs and trunk muscles.

## **AMPUTATION SURGERY**

Ambi” means around

Putatio” means trimming

Separation by cutting of a terminal part of the body. Amputation surgery includes removal of a part or whole limb to exclude pathology and reconstructive to create a best possible stump.

## **DECISION MAKING VARIABLES IN LIMB SALVAGE**

### ***A) Patient***

1. Age
2. Chronic disease (eg:Diabetes)
3. Occupational consideration
4. Patient and family desire

### ***B) Extremity***

1. Mechanism of injury
2. Fracture pattern
3. Arterial venous injury
4. Neurological status (anatomic)
5. Injury status to ipsilateral foot
6. Ischemia zone after revascularization

### ***C) Associated***

1. Magnitude of associated injury
2. Severity and duration of shock
3. Warm ischaemic time

### **TYPES OF AMPUTATION:**

1. Guillotine amputation
2. Definite amputation
3. Revision amputation

### **GOOD STUMP**

Proper length

Proper shape

Skin is free

Scar is healthy and free

Muscle having good power

Joint should have full range of movement

No neuroma

No phantom sensation or pain

### **ACUTE POST-OPERATIVE CARE**

***The stump is maintained postoperatively by***

Soft or rigid dressing

Crepe bandaging

Controlled environment method

Immediate post operative prosthetic fitting

## **PRE PROSTHETIC PHASE**

The pre prosthetic phase plays a main role in the successful outcome of prosthetic fitting and usage.

*The goal at this stages are*

- Pain control, maintenance of range of motion and strength and promotion of wound healing.
- General endurance and strengthening exercise should be implemented and exercise should stabilize the proximal muscles and avoidance of joint contractures.
- Strengthening of upperlimb musculature is essential for wheel chair propulsion, transfers and ambulation with crutches or a walker.
- Removable rigid dressing or elastic compressive dressing are used to control pain and residual limb maturation.
- Skin desensitization program that includes gentle tapping, tissue massaging, scar mobilization and lubrication required.
- Modified stationary bicycle ergometer or universal below knee tricycle attachment or versa climber used to assist in strengthening and endurance in lowerlimb amputation.

- The normal limb must be evaluated as to range of motion, strength, sensation, co- ordination, skin integrity, vascularity and deformities.
- Cardiac and Pulmonary status is evaluated by means of clinical parameters such as heart rate, blood pressure and respiratory rate.
- Nutritional, cognitive and psychological evaluation are also important.
- Presence of comorbidities such as diabetic retinopathy and degenerative joint disease, neuropathy, poly neuropathies also influences rehabilitation outcomes.
- Sitting balance, bed mobility and transfers are facilitated by strong, flexible back and abdominal rotators, flexors and extensor and hip extensors.
- Contractures if present treated by heating modalities, prolonged passive stretch, spring loaded orthosis, serial casting, nerve blocks or soft tissue surgery.
- Ambulation training without prosthesis is important .Once the patient can manage standing then ambulation (Hopping) using the parallel bar. Once balance improved then patient may advance to a walker and then crutch walking.



- Exercise programme for amputee focused on

Flexibility

Muscle strength

Cardiovascular training

Balance

## **PROSTHETIC TRAINING**

- After patient received prosthesis, frequent monitoring of the skin allows for prompt corrections of socket-fit problems and prevents skin break down.
- Walking programme should start conservatively and progress gradually 30- 40 minutes per session.
- A pre-gait program starts in the safety of the parallel bars under the close supervision of the therapist.
- Balance training / co-ordination is also essential. Gait training includes weight bearing, weight transfer, stepping training, walking with or without assistive aids, stair climbing etc...
- Cleaning and maintaining of prosthesis is important.

## **COMMUNITY REINTEGRATION**

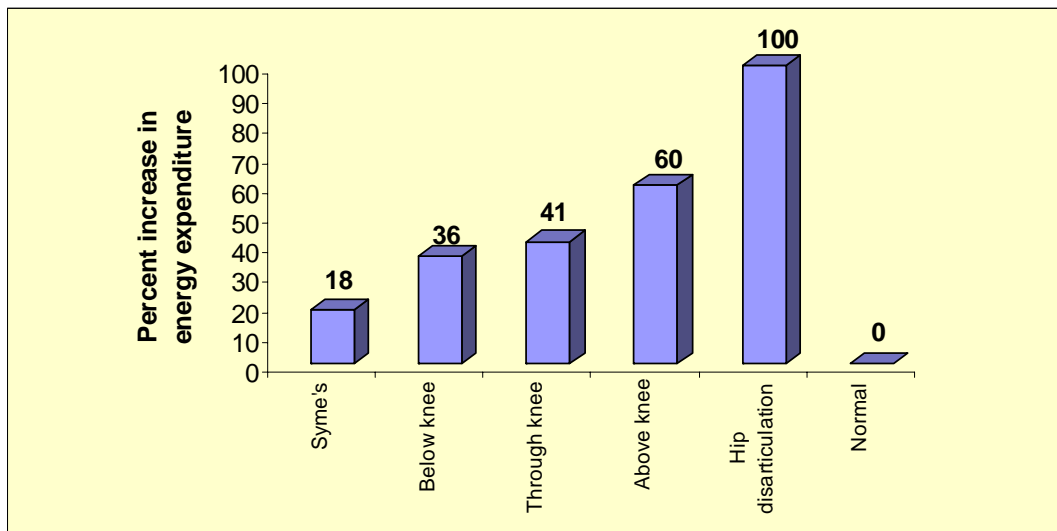
Day rehabilitation program is one, where the patient participates in rehabilitation for 3 hours a day, 5 days a week, or 6 hours a day, 2 to 3

days a week. This allows them to return to a part-time modified work, sports and social activities.

## **LONG TERM FOLLOW UP**

The patient who has successfully completed a rehabilitation programme should be seen for follow-up by one of the team members atleast every 3 months for first 18months .Physician follow-up every 6 months is recommended. These scheduled visits may need to be more frequent and include other members of the team if patient is having difficulties with prosthetic fitting, the residual limb, specific activities or psychosocial adjustment.

## **ENERGY EXPENDITURE DURING AMPUTATION WITH DIFFERENT LEVELS OF LOWERLIMB AMPUTATION:**



<b><i>No</i></b>	<b><i>Phases</i></b>	<b><i>Levels of Amputation Hallmarks</i></b>
1.	Preoperation	Medical and body condition assessment, patient education, surgical level discussion, phantom limb sensation
2.	Amputation surgery	Residual limb length determination, myoplastic closure, soft tissue coverage, nerve handling, rigid dressing application, limb construction
3.	Acute post surgical	Wound healing, pain control, proximal body motions, emotional support, phantom limb discussion
4.	Pre prosthetic	Residual limbs shapping, shrinking, increasing muscle strength. Restoring patient sense of control
5.	Posthetic prescription	Team consensus on prosthetic prescription
6.	Prosthetic training	Prosthetic management and training to increase wearing time and functional use
7.	Community integration	Resumption of family and community roles, regaining emotional equilibrium, developing health coping strategies, recreational activities
8.	Vocational rehabilitation	Assessment and training for vocational activities. Assessment of further education needs or job modification
9.	Follow up	Life long prosthetic, functional and medical assessment, Emotional support

## **PROBLEMS IN STUMP**

### **ACUTE COMPLICATIONS**

- 1) Hemorrhage/Haematoma
- 2) Stump edema
- 3) Wound gaping
- 4) Infections
- 5) Delayed wound healing
- 6) Deep vein thrombosis

### **DELAYED COMPLICATIONS**

- 1) Skin complications
  - Increased sweating
  - Skin ulceration
  - Skin infections
  - Adherent scar
  - Dog ear
- 2) Bony complications
  - Osteoporosis
  - Fracture of stump
  - Stump Osteophytes
  - Osteomyelitis
  - Overgrowth(in pediatric amputee)
- 3) Neuroma
- 4) Contractures
- 5) Muscle wasting

- 6) Phantom sensation
- 7) Phantom pain
- 8) Psychological Problems

## **SKIN COMPLICATIONS**

### ***Skin Ulceration***

- Anaesthetic stump – unnoticed minor injury with continued trauma in conditions like spina bifida, leprosy and diabetes leads to ulceration.
- In vascular diseases deficient arterial perfusion augmented by pressure and infection leads to ulceration.
- Infection may be a primary infection of the stump or secondary to trauma or ischaemia.
- Prosthetic cause: Point of excess pressure lead to discomfort and ulceration, not wearing socks, faulty weight load or pressure at a particular point on stump, pressure over grafted skin, pressure at lower end.

### ***Skin Infection***

Fungal infection secondary to perspiration is quite common. Infected hair follicles are treated by plucking of the infected hair and with antibiotics.

### ***Adherent Scar***

Adherence of scar to underlying bone leads to development of stress during ambulation and lead to ulceration.

### ***Dog Ear***

Excess skin flap leads to formation of dog ear. It can be avoided by proper mapping of flap before surgery and adequate trimming at the time of surgery

### **BONY COMPLICATIONS**

1. Osteoporosis
2. Fracture stump
3. Bone spurs
4. Bony overgrowth

### ***Neuroma***

Bulbous swelling at the cut end of the nerve is called a neuroma. The peripheral nerve, when transected, will attempt to regenerate by the growth of neurofibrills. In the absence of distal segment the neurofibrills at the stump grows into a disorganized mass called neuroma.

#### ***Neuroma may be***

- i. at major anatomical nerves
- ii. Cutaneous nerves in the scar tissue of stump at the lower end.

### *Prevention of Neuroma*

- During surgery, the nerve is divided with sharp blade after gentle traction and allowed to retract proximally into soft tissues.
- Crushing of the nerve end and cauterisation to prevent regeneration.
- Neurolytic agents like phenol or absolute alcohol into nerve end.
- The severed nerve end is buried within bone
- Nerve end is enclosed in silicone cups.

### *Management of Neuroma:*

Neuroma are painful only when subjected to pressure or shear. It can be managed by

- Pressure relief in prosthesis at the site of neuroma.
- Ultrasound / TENS (Transcutaneous Electrical Nerve Stimulation) over painful area.
- Injection of a local anaesthetic with or without steroids.
- Desensitization by tapping and kneading massage from early post operative Period.
- Surgical excision of neuroma.

## ***Phantom Sensation***

The sensation of presence of the amputated part is called phantom sensation.

First sensation to appear is

1. To scratch the chin with the absent hand
2. To walk on missing leg
3. Phantom sensation is absent in
  - a. Congenital limb deficiencies
  - b. Amputation before 4 years.
  - c. Patients with brain damage
  - d. Amputation of anaesthetic limbs.

The reason for phantom sensation is explained by various theories of neuro projection like unablation of the cortical representation. The perceptions remembered by the cortex is said to produce phantom sensation. This also explains the reason why the deformity or problems before amputation continues as phantom sensations.

The sensation tends to disappear in duration of time. The last sensation to disappear is sensation from missing thumb or great toe.



### ***Phantom pain***

Painful disagreeable sensation with strong paresthesia in absent limb is called phantom pain. Phantom pain may be constant or intermittent. Phantom pain can be precipitated by

- a. Contact with painful stump
- b. Trigger area anywhere in body
- c. Urination/inter course/angina
- d. Emotional

### **THEORIES OF PAIN**

#### ***Central theory***

The reticular activating system which has inhibitory control on pain gets initiated by sensory input from the limb. When large proportion of sensory fibres are destroyed by amputation it results in decreased inhibitory control by reticular activating system. The somato sensory projection areas develop a self sustaining neural activity thus causing pain.

#### ***Peripheral Theory***

Spontaneous activity and painful sensory input is received by brain from the severed nerve site. Misinterpretation by the brain on the origin of the input of pain sensation.

### ***Psychological Theory***

Emotional disturbance especially immediately after amputations, difficulty in using prosthesis or refusal to use prosthesis results in establishment of phantom pain.

### ***Types of Pain***

1. Cramping pain like muscle spasm
2. Electric shock like pain that lasts for few seconds and it is lancinating and Episodic.
3. Burning pain felt throughout the stump and phantom limb.
4. Squeezing pain.

### ***Ten point program in treatment of phantom pain***

- 1) Preoperative preparation of patient about phantom sensation that it is normal and is not harmful.
- 2) Post operative examination of stump daily and advise to use the residual limb or stump.
- 3) Normal healing of stump is essential as infection and complications more likely to cause phantom sensation.
- 4) Massaging the stump and then toughening the skin by gentle pounding without damaging the skin.

- 5) Exercise the stump muscles with imaginary movement eg. Pedaling an imaginary bicycle.
- 6) Provide prosthesis as soon as possible.
- 7) Local blocking agents like ethyl chloride spray, local procain injection.
- 8) Physical therapy.
- 9) Drugs
  - a. Beta blockers
  - b. Anticonvulsants
  - c. Carbamazepine
  - d. Phenytoin
  - e. Chlorpromazine
  - f. Antidepressants
    1. Amitriptylline
    2. Imipramine
- 10) Surgical modalities
  - a. Anterolateral cordotomy
  - b. Thalamic tractomy
  - c. Sub cortical neurectomy ablation of somatosensory cortex
  - d. Electrical stimulation of dorsal column of spinal cord.

## **IMMEDIATE POSTOPERATIVE PROSTHETIC FITTING (IPOP)**

It was first described by Berlemont in 1961 but weiss popularized the technique in 1996.

A temporary prosthesis was applied in operating room at the conclusion of amputation. The most commonly used IPOP consists of a rigid plaster cast carefully molded to a patellar tendon bearing configuration to which pylon and foot is attached.

Patient starts touch down weight bearing within 24-48 hours after surgery. Gradually weight bearing is increased with training in parallel bars and then with walkers and crutches.

### ***Advantages of IPOP***

1. Reduces pain and edema
2. Prevents muscular atrophy
3. Prevents contracture
4. Provides good motivation
5. Reduces chances of phantom pain
6. Speeds up rehabilitation.

### ***Disadvantages***

1. Increased incidence of wound gaping
2. Delayed wound healing

### 3. Infection of wound

#### *Immediate prosthesis after wound healing*

- This is done after suture removal and wound healing
- Immediate prosthesis after wound healing is safe
- Because of problems with IPOP, most surgeon advice temporary prosthesis after the wound is safe for touch down weight bearing
- Harris (1997) advised prosthetic fitting after 7-10 days of amputation.
- Eraklis and wheeler (1963) advised prosthetic fitting after 2-3 weeks.

## **GAIT ANALYSIS IN AMPUTEE**

### **GAIT ANALYSIS IN TRANSFEMORAL AMPUTEE**

Both static and dynamic evaluation has to be done

#### *Before donning of prosthesis*

1. Prosthesis meets specifications and prescription
2. Inside of the socket is smoothly finished
3. Joints moving freely

#### *Sitting with prosthesis*

1. Socket is suspended securely
2. Shank equal to opposite side

3. Sitting comfortably without pinching
4. Able to lean forward to touch toes

### ***Standing with prosthesis***

1. Socket fits properly
2. Knee is stable on weight bearing
3. Pelvis on level in both sides.
4. Socket is in good contact on all side
5. Adductor roll does not get pinched
6. Pressure on pubic ramus

### ***Walking***

1. Heel rise adequate to clear ground
2. Prosthetic knee bends smoothly
3. Leg swings forwards with adequate knee and hip flexion
4. Knee extends before next heel contact
5. Stride length equal on both sides.

## **GAIT ANALYSIS IN TRANSTIBIAL AMPUTATION**

### ***Before donning of prosthesis***

1. Prosthesis meets specification and prescription
2. Inside of the socket is smoothly finished
3. Joints if available are freely moving.

### *Sitting with prosthesis*

1. Comfortable
2. Foot flat on ground
3. Adequate relief to hamstrings
4. Stump fit to socket
5. Suspension loosens /tightens
6. Both knees at level
7. Color matching to normal limb

### *Standing with prosthesis*

1. Interface between stump and socket
2. Knee stability and knee flexion
3. Pelvis on level
4. Foot flat on standing
5. Gaping at brim of socket

### *Walking*

Check for

1. Ball of foot more than 2.5 cm from floor
2. Knee extended on all phases
3. Unequal stride length.

## REHABILITATION TERM AND THEIR ROLES

### MEMBERS AND ROLES OF THE MULTIDISCIPLINARY TEAM FOR REHABILITATION AFTER AMPUTATION:

<i>Sl. No.</i>	<i>Team Members</i>	<i>Role</i>
1.	Physician	<p>Serves as co-ordinator of the team</p> <p>Assesses need for amputation, perform surgery, monitor healing.</p> <p>Monitor and manages patient's overall medical care.</p>
2.	Physical Therapist	<p>Provides preoperative education about the rehabilitation process and instruction in single limb mobility.</p> <p>Designs preprosthetic rehabilitation program that focuses on mobility and preparation for prosthetic training.</p> <p>Designs prosthetic training progress that focuses on functional ambulation.</p>
3.	Prosthetist	<p>Designs, fabricates and fits the prosthesis</p> <p>Adjust alignments, repairs/replaces components when necessary.</p> <p>Monitors fit, function and comfort of the prosthesis.</p>
4.	Occupational therapist	<p>Assesses and treat patients with upper extremity amputation, monitors readiness for prosthetic fitting.</p> <p>Assists with problem solving in activities of daily living.</p>



<b><i>Sl. No.</i></b>	<b><i>Team Members</i></b>	<b><i>Role</i></b>
5.	Social Worker	<p>Provides financial counseling and co-ordination of support services.</p> <p>Acts as liaison with third party payers and community agencies.</p> <p>Assists with patient's and family's, social, psychological and financial issues.</p>
6.	Dietician	Evaluates nutritional status and provides nutritional counseling for Diabetes Mellitus, heart diseases and those on chemotherapy.
7.	Nurse	<p>Monitors patient's health and functional status during rehabilitation.</p> <p>Monitors condition of remaining extremity for patients with PVD, Neuropathy or diabetes.</p>
8.	Vocational Counselor	<p>Assesses patient's employment status and potential.</p> <p>Assists with education, training and placement.</p>

## **OBJECTIVES**

The primary aim of this retrospective study is to assess the cause of amputation in south Indian population and preventive measures needed to safeguard the general population to lead a healthy and peaceful life.

## **MATERIALS AND METHODS**

### **POPULATION**

Government Institute of Rehabilitation Medicine is a main catering Institute for the disabled persons not only from northern part of Tamilnadu, also from Pondicherry, border area of Andra Pradesh and Karnataka. Even from southern most part of Tamilnadu patients are referred here for management.

About 369 amputee patient admitted in this Institute from January 2007 to December 2010 were included in this study.

### **SETTING**

Tertiary care center, Government Institute of Rehabilitation Medicine, Chennai-600083, under Madras Medical College and Research Institute.

### **PERIOD OF STUDY**

Four years from January 2007 to December2010.

### ***Inclusion criteria***

All amputee patients admitted for prosthetic fitting in 2007 to 2010 are included in this study.

### ***Exclusion criteria***

1. Amputee patient due to malignancy associated with life threatening secondaries not eligible to fit prosthesis.
2. Amputee patient who come for physically handicapped certificate.

### **SAMPLE SIZE**

Only 369 patients conformed to the above criteria during the period January to December 2010.

### **OUTCOME MEASURES**

Each patient was assessed according to the proforma covering various aspects like age, sex, causes, habits and level of amputation.

The data collected from above proforma was subjected to descriptive analysis like percentage and tables. Due to strict protocol and consequencing of cases, have reduced bias.

## **HIP DISARTICULATION WITH PROSTHESIS**



## **ABOVE KNEE AMPUTEE WITH PROSTHESIS**



## KNEE DISARTICULATION WITH PROSTHESIS



## **VARIOUS LEVEL OF AMPUTATION IN TRANSTIBIAL**



## **BELOW KNEE AMPUTEE WITH PROSTHESIS**





### **SYME'S AMPUTEE WITH PROSTHESIS**



### **CHOPART AMPUTEE WITH PROSTHESIS**





## ABOVE ELBOW AMPUTEE WITH PROSTHESIS



## BELOW ELBOW AMPUTEE WITH PROSTHESIS



## **FINGER AMPUTATION WITH PROSTHESIS**

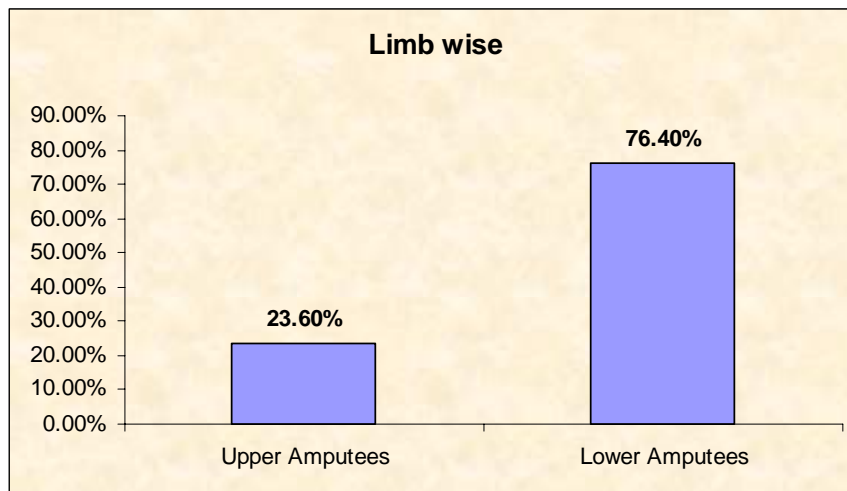


## **CONGENITAL DEFICIENCY WITH PROSTHESIS**



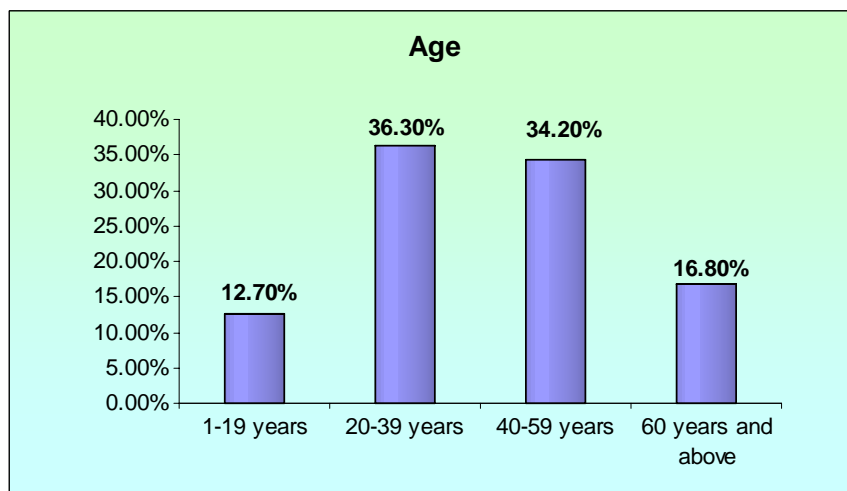
## OBSERVATION AND RESULTS

The number of amputee patients taken up consecutively for the study is 369.



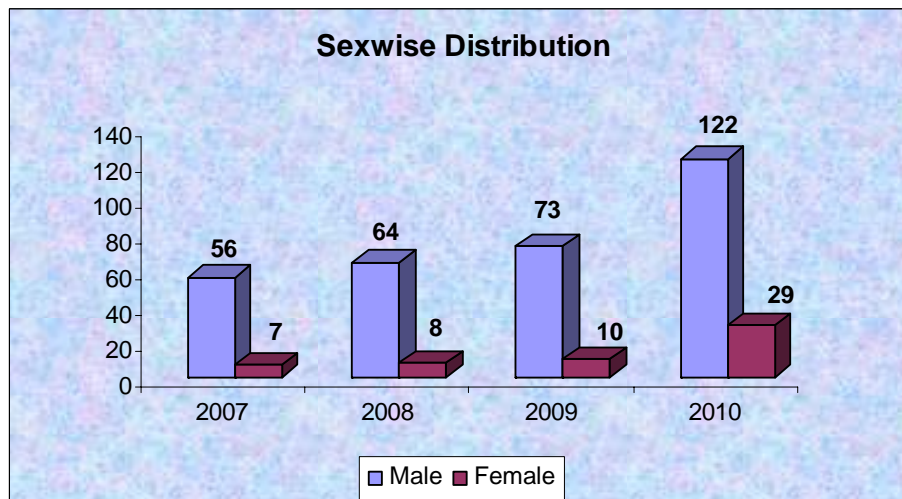
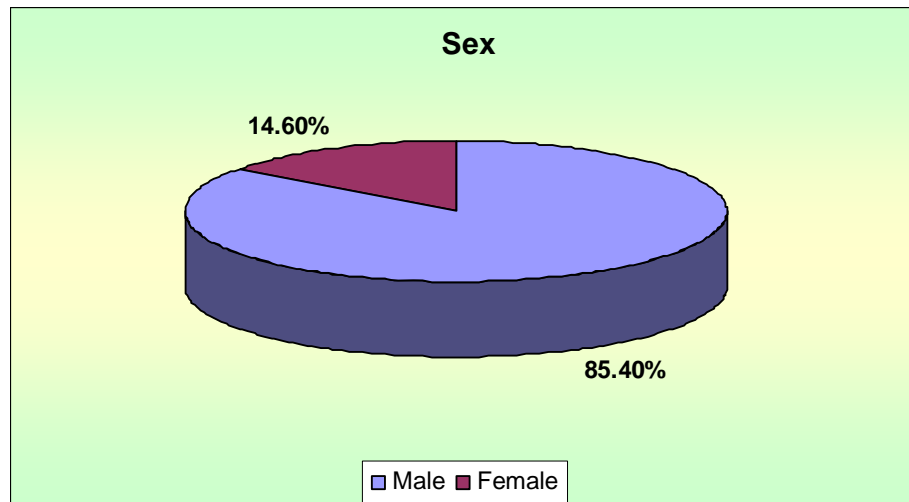
### AGE

The youngest is 3years and the oldest is 70years and the mean age of patient in the study is 30years and 36.3% of patient were in the age group of 20-39 years.



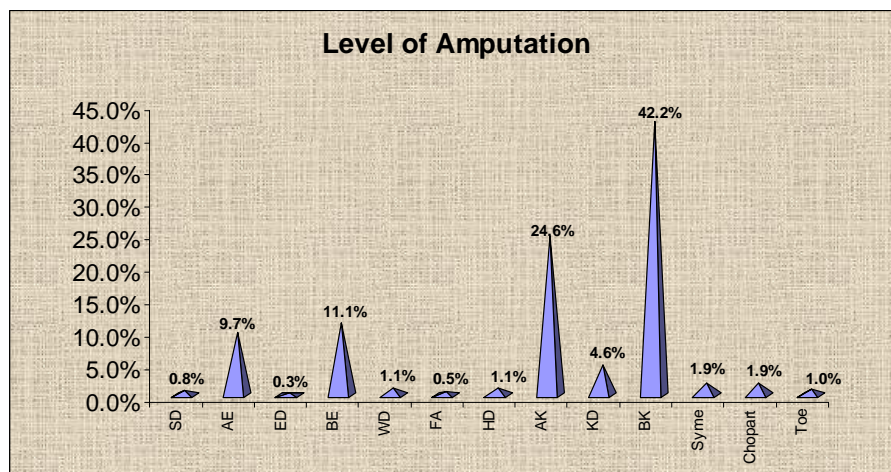
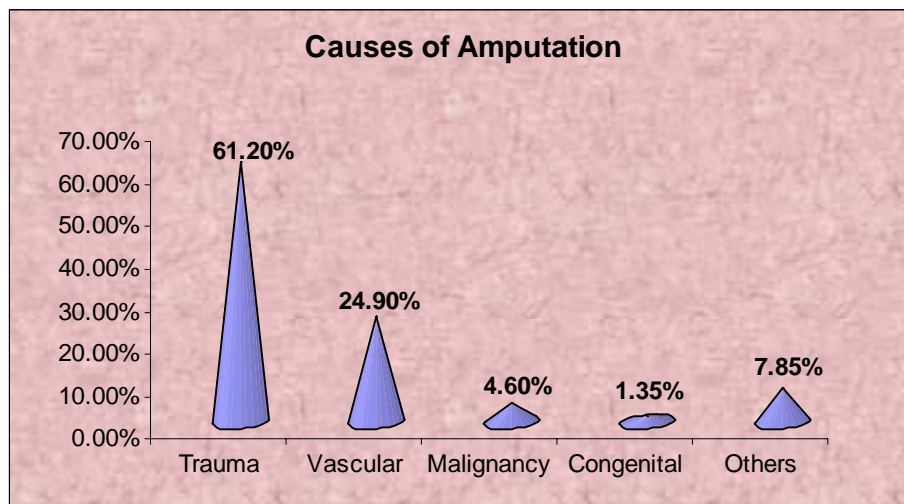
## SEX

Among the 369 patients in the study 315 were males and 54 were females.



## CAUSES OF AMPUTATION

Among 369 patients, amputation due to trauma were about 226 cases ie 61.2%, due to vascular cause were about 92 cases ie 24.9% due to malignancy were about 17 cases ie 4.6%, due to congenital cause about 5 cases ie 1.35%, due to other causes were about 29 cases ie 7.85% .

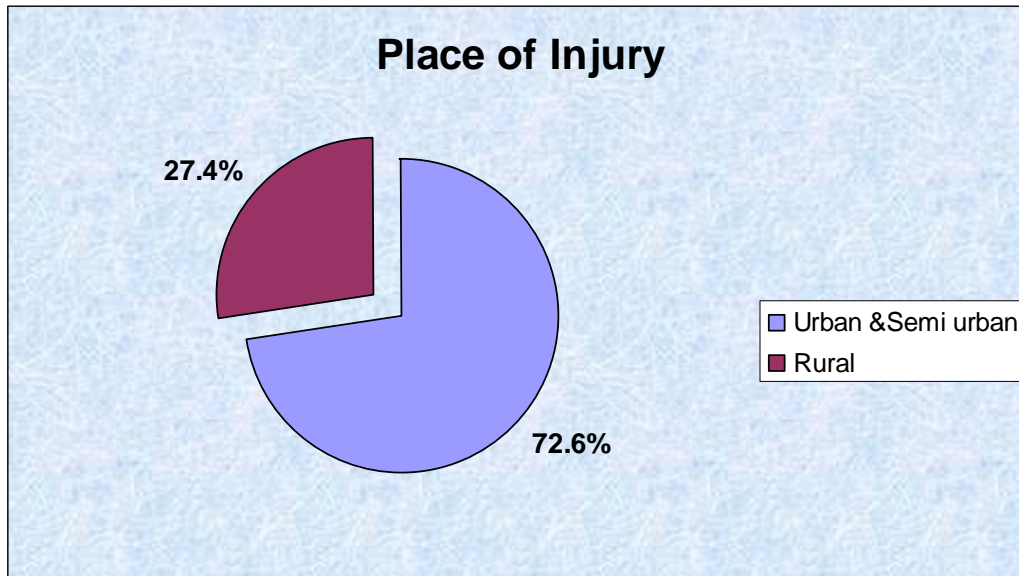


SD- Shoulder disarticulation, AE-Above Elbow, ED-Elbow disarticulation, BE- Below Elbow, WD- Wrist disarticulation, FA-Finger Amputation, HD- Hip Disarticulation, AK-Above Knee, BK- Below Knee



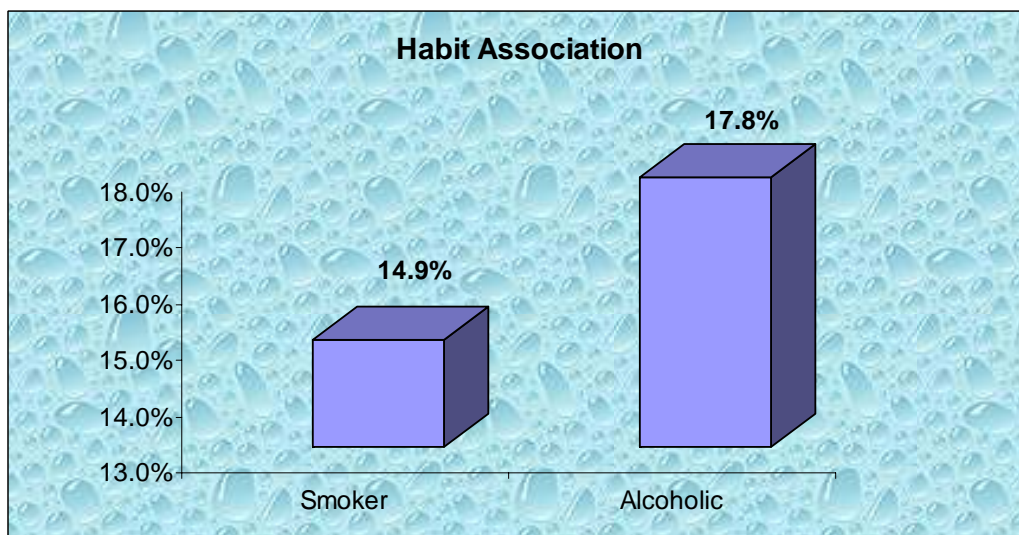
### PLACE OF INJURY AMONG 369 PATIENTS

72.6% patient (268cases) were from urban & semi urban areas,  
27.4% (101cases) from rural.



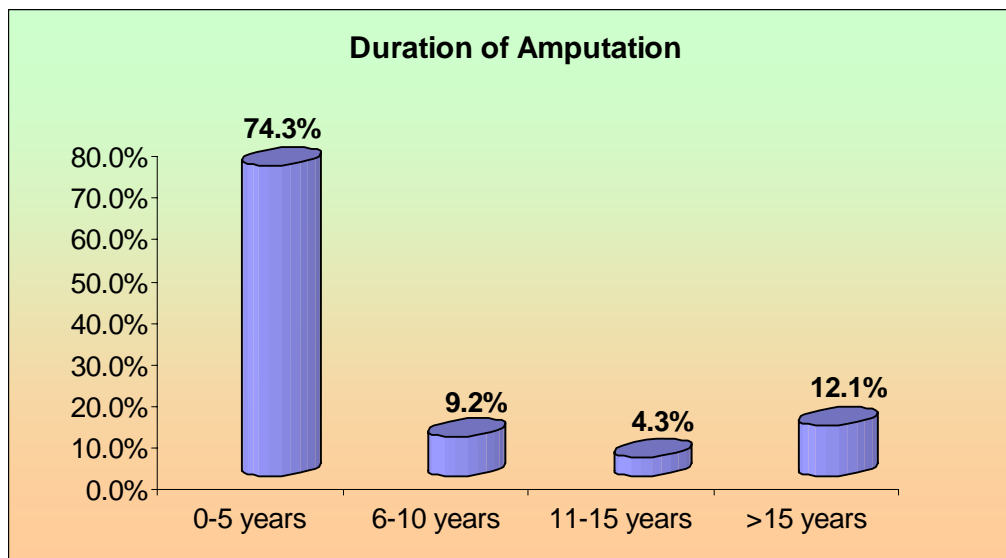
### HABIT ASSOCIATION AMONG 369 PATIENTS

55patients were smokers (14.9%),66patients were alcoholic (17.8%) which may be associated with traumatic injury.



## DURATION OF AMPUTATION AMONG 369 PATIENTS

12.1% patient (45 cases) were of >15 years of duration of amputation which signifies that Prosthetic rehabilitation is effective in this institute.



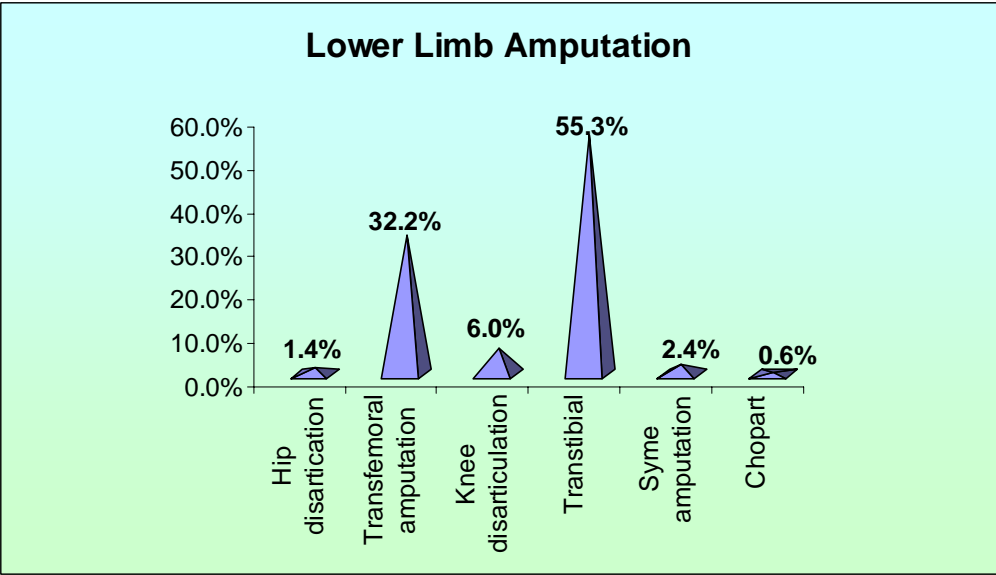
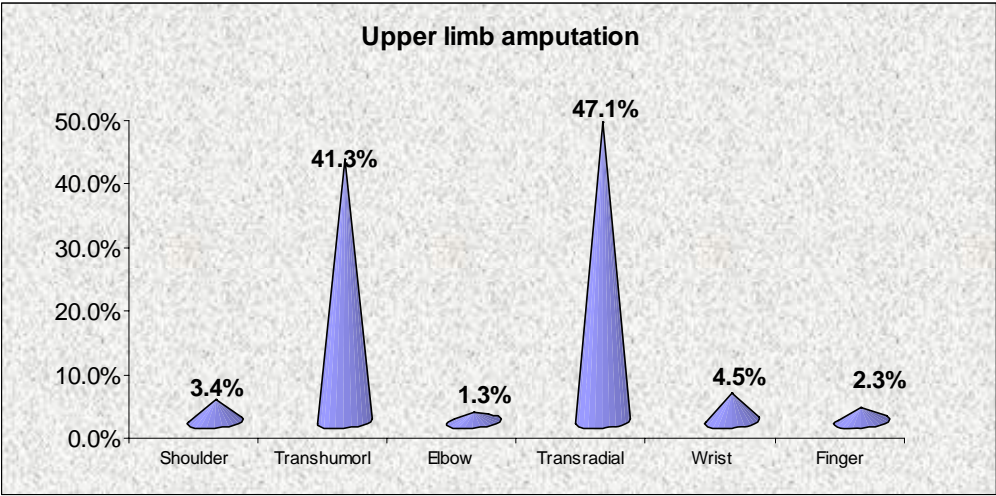
## UPPER LIMBS VS LOWER LIMB AMPUTATION AMONG 369 PATIENTS

282 patients (76.4%) were lower limb amputees

87 patients (23.6%) were upper limb amputees

It is a ratio of 3.2 : 1 (upper limb : lower limb)





## DISCUSSION

This is a retrospective study of causes of amputation among 369 amputees admitted in Government Institute of Rehabilitation Medicine during year January 2007 to December 2010.

The mean age of the patient in this study is 30 years comparable to study from developed countries where mean age is 41 years.

There is male preponderance in this study with 85.4% of the amputees are male with 14.6% females in the ratio of 5.8:1.

About 61.2% in this study is caused by traumatic injury in contrast to 25.86% in U.S study. Comparatively every year there is increase in amputation due to trauma in proportionate to increase in cases. Among 61.2% cases, 6.2% cases were due to machine injury.

About 24.9% cases were due to vascular causes in which 19.5% cases were due to diabetes and 5.4% cases here due to TAO in contrast to developed countries where vascular cause accounts for 46.2% cases. This shows that the incidence of vascular amputation is quite high in Western countries compared to India. In this study in every year diabetes cases in comparison to case load had decreased incidence may be due to effective early diagnosis of diabetes and necessary medical management.

Next cause of amputation in this study was due to malignancy which accounts for 4.6% (17cases) in contrast to developed countries were 0.35% was due to malignancy.

Only 7.85% in this study was due to other causes which include infection, burns, lymph edema, etc.

Only 1.35% in this study was due to congenital anomalies which correlates in to developed countries were the incidence was about 1 to 4%.

The ratio between upper limb and lower limb amputation is 1:3.2 in this study, in contrast to 1:4.9 in developed countries. The probable increase in incidence of lowerlimb amputee may be due to crush injury in Road Traffic Accidents and high incidence of Industrial and Agricultural accidents.

Among upper limb amputation (100%) transradial amputation accounts for 47.1% in this study in contrast to developed countries, where transradial amputation was about 57%. Next was transhumeral amputation which accounts for 41.3% in this study in contrast to developed countries, where incidence of transhumeral amputation was 23%. Why there is much increased incidence of transhumeral in India compared with western Countries has to be looked into and followed for some more years.

Among lower limb amputation, transtibial amputation accounts for 55.3% in this study in contrast to developed countries where it was 59% next common level of lower limb amputation was Tran femoral amputation in this study which accounts for 32.2% in contrast to developed countries where it was about 35%.

In comparison of duration of amputation, 12.1% (45 cases) were about more than 15 years which indicates effective prosthetic rehabilitation done in this institution.

In this study about 72.6%(268 cases) were from Urban and Semi urban areas and 27.4% cases were from rural areas which denotes migration of people from rural to urban areas for jobs and other reasons.

Among 369 cases of amputation 17.8(66 cases) were alcoholic which may be one of the major cause for traumatic injury and 14.9% (55 case) were smokers among which 5.4% (20 cases) were affected by TAO. This shows that smoking not only causes cancer lung but also one of the causes for amputation.

## CONCLUSION

- 1) Amputation with a high male predominance with an average age of 30 years.
- 2) Trauma constitute a major cause of amputation. The second most common cause of amputation is of vascular etiology (Diabetes and TAO)
- 3) Most of amputation can be avoided.
- 4) Industrial accidents can be avoided by taking proper security measures
- 5) Road safety measures should be implemented.
- 6) Amputation due to diabetes can be prevented by proper early diagnosis, control of diabetes by medications, proper foot care and providing appropriate foot wear.
- 7) The incidence of complications of stump can be reduced to a minimum by early rehabilitation.
- 8) Comprehensive rehabilitation centers integrated with community based rehabilitation will further improve the quality of life in the long run and will integrate amputee patients as productive members of the society.

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## **APPENDIX**

### **PROFORMA FOR DISSERTATION**

Case Number:

Primary data:

- 1) Name:
- 2) Age
  - a. 1 - 19 years
  - b. 20 - 39 years
  - c. 40 - 59 years
  - d. 60 and above
3. Address:
4. Sex
  - a. Male
  - b. Female
5. Place of injury
  - a. Rural:
  - b. Semi urban:
  - c. Urban:
6. Mode of injury
  - a. Trauma
  - b. Vascular
  - c. Diabetes
  - d. Congenital
  - e. Others
7. Habit:
  - a. Alcohol
  - b. Smoking



8. Level of amputation

Upperlimb

- a. Shoulder disarticulation
- b. Transhumeral amputation
- c. Elbow disarticulation
- d. Transradial amputation
- e. Wrist disarticulation
- f. Finger amputation

Lowerlimb

- a. Hip disarticulation
- b. Transfemoral amputation
- c. Three distribution
- d. Transibital amputation
- e. Syme's amputation
- f. Chapart ampupation
- g. Toe amputation

9. Duration of amputation

- a. 0-5 years
- b. 6-10 years
- c. 11-15 years
- d. > 15 years